MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2022/2023

EPM1076 –INTRODUCTION TO MACHINES AND POWER SYSTEMS

(RE)

6 JULY 2023
9.00 a.m. - 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 3 pages excluding the cover page with 4 Questions only.

2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

QUESTION 1

(a) Compare the electrical machines and transformers in terms of their power and energy conversion.

[4 marks]

(b) A three phase, 60 Hz transformer has a delta-connected primary and star-connected secondary with the line voltages being 22 kV and 400 V respectively. The secondary is further connected to a star-connected balanced load at 0.8 power factor lagging. Given that the line current on the primary side is 5 A.

(i) Illustrate the three-phase transformer with necessary connections and indicate the line voltages and line current in the diagram.

[5 marks]

(ii) Determine the turn ratio of transformer.

[6 marks]

(iii) Find the line current in secondary.

[6 marks]

(iv) Calculate the total real power supplied by transformer to the star-connected load.

[4 marks]

QUESTION 2

(a) State the purpose of commutator in DC machine. Justify if commutator can be removed from DC machine.

[3 marks]

(b) In a long shunt compound generator, the terminal voltage is 230 V when generator delivers 150A. Given that shunt field, series field and armature resistances are 92 Ω, 0.015Ω and 0.03Ω respectively, determine the:

(i) induced emf, Eg,

[7 marks]

(ii) electrical power developed in armature,

[3 marks]

(iii) power delivered to the load, and

[3 marks]

(iv) identify the power losses during transfer of developed electrical power to output power and calculate the power losses.

[9 marks]

QUESTION 3

(a) Give FIVE advantages of implementing per unit system in power system.

[5 marks]

(b) Given a power transmission system shown in the figure Q3. The rating of the components is listed as below:

Generator G1:	50MVA, 13.8kV, X=0.1 pu
Generator G2:	40MVA, 13.8kV, X=0.2 pu
Transformer T1:	50MVA, 13.8kV/110kV, X=0.07 pu
Transformer T2:	25MVA, 120kV/14.4kV, X=0.03 pu
Motor M1:	25MVA, 14.4kV, X=0.3 pu

The static load impedance value is (2.3+j2.6) Ω. Select a common base of 25MVA, 14.4kV at the motor side, draw the impedance diagram.

[20 marks]

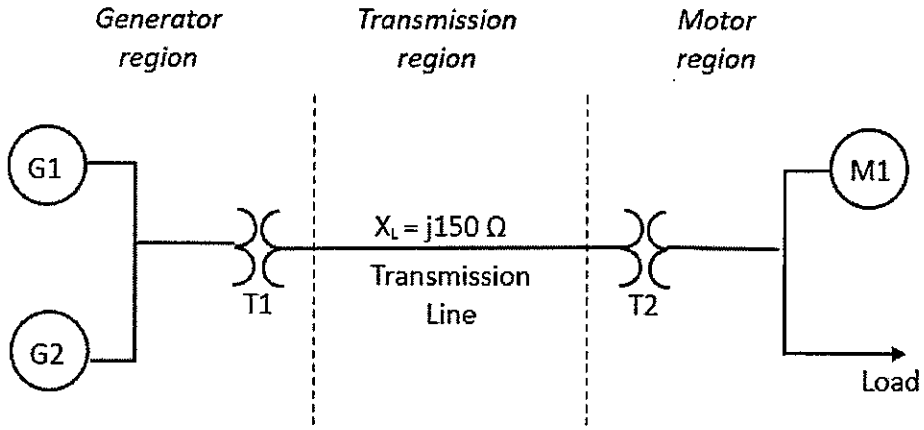

Figure Q3

QUESTION 4

(a) One of the protection schemes in power system is over current protection scheme. Under this scheme, the relay will monitor and sound the alarm if the current flow is exceeding the so-called pick up current. State the maximum and minimum conditions that must be satisfied in setting up the pick-up current to the best detection of fault current.

[4 marks]

(b) Illustrate how an equipment can be protected under differential current protection scheme in a power system and briefly describe the conditions to detect a fault.

[4 marks]

(c) Determine the time multiplier setting of a 5A, Inverse Definite Minimum Time (IDMT) relay having a current setting of 100% to clear a fault current of 4500A in 1.5s. The relay is connected to a supply circuit through a 300A/5A current transformer. The relay characteristics are given in Table Q4.

[9 marks]

(d) An IDMT overcurrent relay has a current setting of 150% and a time multiplier setting of 0.6. The primary of the relay is connected to the secondary of CT having current ratio of 400A/5A. A circuit breaker associated with relay is installed at the transmission line and would take about 0.2s to fully operation. Calculate the total operating time of protection scheme if the circuit carries a fault current of 6000A. The time-current characteristics of the relay is shown in Figure Q4.

[8 marks]

Table Q4

PSM	2	4	6	8	10	12	14	16	18
T	7.5	6	5	4.5	4	3	2.8	2.5	2

Operating time of relay = T x TMS

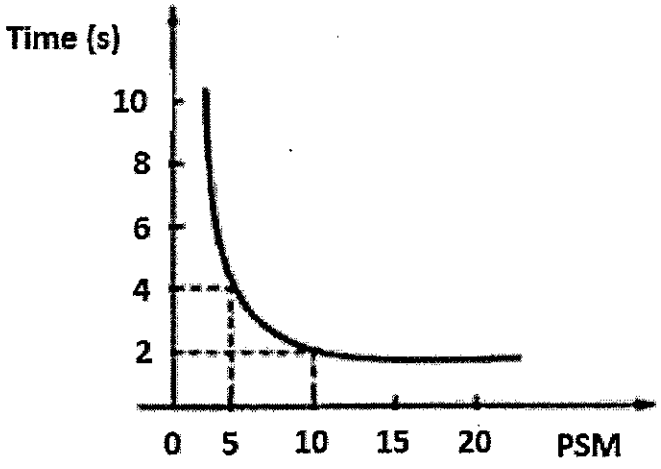

Figure Q4

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